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NOTICES.

DARTONFIELD ESTATE—VISITORS' DAYS

The *second* and *fourth* Wednesdays in each month have been set aside as Visitors' Days at Dartonfield estate, and the services of technical officers will be available to visitors on those days. The estate superintendent will be available every Wednesday. Visitors are requested to arrive on the estate not later than 9-30 a.m.

While visitors will be welcomed at the Station on other days, any particular member of the staff may not be free to give them attention unless an appointment has been made.

Dartonfield estate is situated about $3\frac{1}{2}$ miles from the main Matugama-Agalawatta Road, the turn-off being near culvert No. 14/10. The distance from Colombo is approximately 47 miles.

PUBLICATIONS

Rubber Research Scheme publications comprising Annual Reports, Quarterly Circulars and occasional Bulletins and Leaflets, are available without charge to the Proprietors (resident in Ceylon) Superintendents and Local Agents of Rubber estates in Ceylon over 10 acres in extent. Application for registration should be made to the Director, stating the name, acreage, and registered number of the estate(s) concerned.

IDENTIFICATION OF CLONES

The attention of Proprietors and Superintendents undertaking replanting or budgrafting programmes is drawn to Planting Manual No. 5: "The History and Description of Clones of *Hevea Braziliensis*" issued by the Rubber Research Institute of Malaya, copies of which may be purchased on application to these Laboratories for Rs. 5-00 each (postage free.) This publication gives drawings and descriptive particulars of the more important clones, which should enable Superintendents to verify the authenticity of their material.

FIELD EXPERIMENTS ON DARTONFIELD ESTATE—VI. MANURING EXPERIMENT WITH MATURE RUBBER

R. K. S. MURRAY,
BOTANIST AND MYCOLOGIST

AND

C. A. DE SILVA,
ASSISTANT BOTANIST

INTRODUCTORY.

THIS paper summarises the first year's yield records and growth measurements in connection with the manuring experiment on Dartonfield Estate. The scope, design and management of the experiment were described in No. 2 of this series in Rubber Research Scheme *Quarterly Circular* Vol. 13, Parts 2 and 3, 1936, and this information is first briefly recapitulated.

TREATMENTS.

The several treatments may be represented as follows:—

N = Nitrogen only

NP = Nitrogen plus phosphoric acid

NK = Nitrogen plus potash

NPK = Nitrogen plus phosphoric acid plus potash

O = No manure

The manuring is carried out on a tree basis, the quantities being calculated so that N = P = K = .4 lb. per tree. The fertilisers used are:—

N as Sulphate of Ammonia

P as Mineral Phosphate

K as Muriate of Potash

Calculated on the stack analyses in December, 1936, when the first applications were made, the quantities of the three fertilisers were:—

Sulphate of Ammonia	...	1.90 lbs. per tree
Mineral Phosphate	...	1.32 ,, ,, ,,
Muriate of Potash	...	.77 ,, ,, ,,

Thus the plots with the complete fertiliser received about 4 lbs. per tree of a balanced mixture. The applications are to be repeated annually, but the second dose given in December, 1937, cannot have affected the results at present under review.

In addition, a comparison is being made between two methods of applying the manure viz:—

(1) Envelope forking Pueraria and other green loppings together with the fertiliser.

(2) Broadcasting the fertiliser.

Up to the present this comparison has not become fully operative as the ground cover of Pueraria, which was planted at the commencement of the experiment, is not yet sufficiently dense to cut. The comparison, therefore, simply becomes "forking vs. broadcasting."

Layout.—The unit plot size is 20 trees. There are four main blocks each divided into two sub-blocks. Each sub-block is a complete replication of the five fertiliser treatments, and the two methods of applying the manure are allotted to the sub-blocks in randomised pairs. Thus the main treatment comparison is replicated eight times, and the comparison between methods of application four times.

Tapping.—The system of tapping is the Double-Four. One sub-block of 100 trees constitutes a tapper's task and the tappers are rotated between sub-blocks every two months. In this way any variation due to the skill of different tappers is eliminated. The order in which the several plots within a block are tapped is changed daily in rotation.

The height of the cuts is somewhat variable as tapping had to be continued in whatever position the cuts happened to be, but measurements made early in 1937 showed that the averages for the various treatments were satisfactorily uniform.

Recording.—The yield of each plot is recorded for every tapping in grams of latex. A determination of the dry rubber

content is made by trial coagulation and the weight of dry rubber thus calculated. The scrap is also weighed. Days on which the latex cannot be fully collected owing to rain are disregarded.

Age of Trees.—The age of the trees in 1937 was 24 years in Blocks 1 and 2, 27 years in Block 3 and 20 years in Block 4.

RESULTS.

Yield.—Before considering the yield figures some indication must be given of the statistical methods employed.

During 1936, *i.e.* before any manure was applied, the experimental blocks were tapped and plot yields recorded just as if the experiment proper were in progress. The object of this preliminary year's uniformity trial was to study the initial variations between plots and thus to provide a basis on which the subsequent experimental yields could be adjusted. To the lay mind the most obvious means of correction is to calculate the percentage increase or decrease on the preliminary figures, but the statistician does not consider this procedure satisfactory and the statistic actually employed is the "regression coefficient." The inference that the yield of a plot in the "preliminary" year is any guide to its yield in a subsequent "experimental" year implies that the expectation of yield is well represented in terms of the previous performance by a linear regression function. If the yields in the preliminary and experimental years be denoted by x and y respectively, then the appropriate regression coefficient b is given by the ratio $\frac{\text{Cov}_{xy}}{\text{V}_x}$, where Cov_{xy} is the covariance of the preliminary and experimental yields, or the mean product of their deviations from their means, and $\text{V}x$ is the residual variance of the preliminary yields. The yield for any treatment in the experimental year is then adjusted by deducting from it the factor $b(x-\bar{x})$, where $\bar{x}$ is the general mean for the preliminary year. That the application of this method to Rubber results in an appreciable increase in precision has been shown by the senior author [1], working with figures from Sumatra.

Table I gives the yields for the preliminary year 1936, for the experimental year 1937 and for 1937 adjusted for 1936 according to the above formula. The yields are expressed in

kilograms per plot of 20 trees rather than in terms of pounds per acre for two reasons: in the first place, the determinations are made on a tree and not on an area basis and the stand of trees per acre is not the same in each of the experimental blocks, and secondly, "wash-outs," complete and partial, are excluded from the records so that a calculation in terms of pounds per acre would under-estimate the actual crop obtained. As an approximate conversion to pounds per acre each figure should be multiplied by 11.

TABLE I

MEAN YIELDS IN KILOGRAMS DRY RUBBER PER PLOT OF 20 TREES.

Treatment	Preliminary year 1936 (x)	Experimental year 1937 (y)	Adjusted yields $y - b\ (x - \bar{x})$
N	53.4	50.2	49.8
NP	52.3	46.9	47.5
NK	55.5	51.2	49.1
NPK	56.5	52.6	49.6
O	47.1	39.9	44.8
Means	53.0	48.2	48.2
		Standard Error	1.2
		Significant difference (P = 05)	3.5

Attention is first directed to the last column in which the adjusted experimental yields are given. Statistical analysis shows that judged by a 20: 1 probability the treatment effect is just significant and that differences of 3.5 kg. or more are real. On this basis the yield of the control plots is seen to be significantly lower than that of any of the manured plots except NP. The latter, however, does not differ significantly from the other fertiliser treatments. One would thus conclude that Nitrogen, by itself and with the minerals, has already exercised

a beneficial effect on yield. If, however, the more severe test of significance (100:1) is applied the treatment effect is found to be not significant, and the authors prefer to regard the differences in this light for two reasons:—

(1) Reference to the second column in Table I will show that even in the preliminary year 1936, before any manure was applied, the average yield of the plots which were subsequently to become the controls was appreciably lower than that of any of the other hypothetical treatments. This was due to an unfortunate random arrangement. Although compensation for the initial differences is made by the technique described above, the correlation between yields in successive years is not perfect, and if the general tendency were for the yields to be on the downward grade (as, indeed, appears to be the case), it might be expected that the poorest plots would decrease more rapidly than the best.

(2). The measurements of girth increase and bark renewal given below do not indicate any significant differences between the treatments. Both these measurements are functions of the growth of the tree, and since it has been noted in other experiments of a similar nature that response to fertilisers is shown more rapidly in growth than in yield, the apparent increase (or relative increase) in yield shown in Table I must be viewed with suspicion.

In Table II is shown the comparison between "forked" and "broadcast" sub-blocks. The difference is not significant.

TABLE II

MEAN YIELDS IN KILOGRAMS DRY RUBBER PER PLOT OF 20 TREES.

Treatment	Adjusted yields
Manure forked in	47.8
Manure broadcast	48.5
Mean	48.2
	Difference not significant

Girth Increment.—The girth of every individual tree was measured at a height of 4 feet from the ground early in March, 1937, and again towards the end of January, 1938. The treatment means, together with the increments for the period of $10\frac{1}{2}$ months, are given in Table III.

TABLE III

GIRTH MEASUREMENTS IN INCHES.

Treatment	1937	1938	Increment 1937/38
N	35.76	36.32	0.56
NP	37.32	37.99	0.67
NK	39.19	39.81	0.62
NPK	37.10	37.74	0.64
O	33.78	34.33	0.55
Mean	36.63	37.24	0.61
			Differences not significant

The treatment effect is not significant, and likewise the method of applying the fertilisers viz. forking or broadcasting, has so far been immaterial.

It is interesting to compare the rate of growth with the figures given by Haines and Guest [2] for a series of experiments in Malaya. They found that the experiments could be divided into two categories: those in which the annual increment at the commencement was less than $\frac{1}{2}$ inch and those in which it exceeded this figure. In the former class could be placed those experiments which gave a ready yield response, and in the latter those in which the response was delayed or lacking. It was thus concluded "that a standard growth rate of about $\frac{1}{2}$ inch per annum forms, for this representative set of experiments, a natural unit below which deterioration is so marked that manuring is urgently called for, but above which the bark is still maintained in a fairly satisfactory condition." Such a criterion could easily be applied on estates and, with suitable adjustment for age of

Since going to press a further paper has been published by Haines [3]. Using an improved technique he now obtains a response to manure in certain cases which were previously negative, and suggests 0.75 inch per annum as a standard growth rate below which the use of fertilisers is indicated.

the trees and local environmental conditions, might prove a valuable means of forecasting the response to manure. Judged by this criterion the figure of .61 in. viz. the mean increment in $10\frac{1}{2}$ months of the trees in the experiment under review, is satisfactory and a rapid yield response is not to be expected.

Bark Renewal.—In January, 1938, measurements were made of the thickness of the renewed bark tapped the previous January. The period of renewal was thus 12 months and was entirely included within the period of manuring. Every individual tree was measured. The instrument used was designed at these laboratories with a view to reducing to a minimum the errors inherent in this type of measurement. The figures are given in Table IV, and it needs no statistical analysis to see that the differences are quite insignificant. Similarly no differences between forking and broadcasting are evident.

TABLE IV

THICKNESS OF 12 MONTHS' RENEWED BARK IN MILLIMETRES.

Treatments	Bark thickness
N	5.1
NP	5.0
NK	5.0
NPK	5.1
O	5.2
Mean	5.1
	Differences not significant

Miscellaneous Observations.—During the course of supervising the second applications of manure in December, 1937, it was noticed that the foliage of the manured plots was, in general, of a better colour than that of the controls. No photometric or other determinations were made to measure the relative shade intensities, nor was any difference between the various fertiliser treatments evident. The leaves are always the first organs of the tree to reflect improved nutrition underground.

The growth of the cover of *Pueraria phaseoloides*, which was planted in 1936, shows a marked response to phosphate, the NP and NPK plots having a much denser cover than the remainder. Nitrogen and potash do not seem to have any beneficial effect.

SUMMARY.

(1). The scope, design and management of an experiment on Dartonfield Estate to determine the fertiliser requirements of mature Rubber are briefly described.

(2). The results for the first year (1937) after the initial application of fertilisers are given in terms of yield, girth increment and bark renewal.

(3). When suitable compensation is made for the initial differences revealed by the uniformity trial carried out in 1936, the control plots are shown to have given a lower yield than the manured plots. This difference is just significant as judged by the .05 probability criterion but not by the .01 standard. For reasons stated it is considered preferable to apply the severer test of significance, and the response is therefore dubious. Other yield differences are inappreciable.

(4). The fertilisers have produced no effect on the growth of the trees as judged either by girth increment or rate of bark renewal.

(5). Observations show that the colour of the foliage has been improved by manuring.

(6). Mineral phosphate has had a marked effect in stimulating the growth of the Pueraria cover.

REFERENCES.

(1). Murray, R. K. S.—Journal of Agricultural Science, XXIV, 2, 1934.

(2). Haines, W. B. and Guest, Evans.—Empire Journal of Experimental Agriculture, IV, 16, 1936.

(3). Haines, W. B.—Empire Journal of Experimental Agriculture, VI, 21, 1938.

PLANTING NOTES.

R. K. S. MURRAY,
BOTANIST AND MYCOLOGIST

TRANSPLANTING DORMANT BUDDED STUMPS.

NOTES under the above heading were published as recently as 1937 in *Quarterly Circular* Vol. 14, Parts 1 and 2, but the number of specimens received almost daily at these laboratories show that certain mistakes in the transplanting procedure are still common, and a further note, therefore, seems called for. In the majority of cases the bud has sprouted and formed the first whorl of leaves, but has subsequently died back despite the fact that the tap root, when excavated, is found to be healthy. Such casualties often appear to occasion surprise though they are nearly always capable of a simple enough physiological explanation.

When a seedling is "stumped" and pulled from the nursery the root system is unavoidably disturbed, and a period of some weeks elapses before any fresh root activity commences. During this period the bud may sprout and form 12-18 inches of stem and a whorl of leaves. The materials required for the formation of these new tissues come from the food reserves stored in the stump and from the water absorbed from the soil. Now it is clear that the mutilated root system is not very efficient as a means of conducting water from the soil to the leaves, and the plant, in fact, is temporarily in much the same condition as a cutting. As soon as the first leaves are formed transpiration proceeds apace, and unless sufficient water can be absorbed to replace the losses the shoot will wilt and die. For the stump to survive the transplanting operation it is thus essential that the production of new feeding rootlets be not unduly delayed.

Experience shows that the success of transplanting is mainly dependent on three factors:—

(1). *Weather Conditions.*—This, of course, is only under control to the extent that planting should be undertaken towards the beginning of what may be expected to be a wet season.

(2). *Treatment on Uprooting from Nursery.*—When uprooting the stumps from the nursery and transplanting them to the field care should be taken to damage the tap and lateral roots as little as possible. In view of the considerations outlined above this is mere common-sense, but the specimens received here for examination show that the harmful practice of pruning the lateral roots flush with the tap root is still prevalent. When a stump with a bare tap root is planted the delay in the formation of new rootlets is greater than if laterals accompany the tap root, and experiments have, in fact, shown that not only are the number of casualties greater if the former procedure is adopted but the early growth of the bud-shoot is slower. If it is necessary for convenience of packing and transport to cut the laterals they should not be severed nearer than 12 inches from the tap root.

(3). *Size of Stump.*—The ideal stump for transplanting has a diameter of $1\frac{1}{4}$ to $1\frac{1}{2}$ inches at the base, and if the size is much less than $1\frac{1}{4}$ in. the results are usually unsatisfactory both as regards losses in the field and early growth. Judged by the specimens received here many estates are planting stumps $\frac{3}{4}$ in. in diameter or less, and the use of such small plants nearly always leads to disappointment.

TAPPING OF BUDGRAFTS.

A considerable number of estates possess budded areas which have attained, or will shortly attain, the requisite girth to be tapped, and since budgrafts differ from seedlings in respect of certain anatomical features which have a bearing on tapping methods, a few notes on the subject may prove useful for the guidance of those tapping budded trees for the first time. In a sense this publication is somewhat premature since certain aspects are still the subject of experimental enquiry, and the following recommendations are issued with the reservation that they may need to be modified in the light of further experience.

The attention of readers may be directed to an article on the same subject by Mr. C. E. T. Mann of the Rubber Research Institute of Malaya reproduced in *Quarterly Circular* Vol. 13, Part 4, 1936.

General Considerations.—The two outstanding anatomical differences between the stems of buddings and seedlings are:—

(1). In buddings the girth, thickness of bark and number of latex vessel rows do not decrease with increasing height to

nearly the same extent as in seedlings. The practical significance of this difference is that budded trees may be tapped higher without so great a loss in crop. Clones vary to some extent in their reaction to different heights, and some give almost the same yield at all levels between about 40 inches and 5 inches. One set of figures derived from 11 clones shows that the yield at 40 inches from the union is 10 per cent less than at 20 inches. For seedling trees the difference would be more than double this figure.

(2). With rare exceptions the budded tree does not possess the heavy cork layer characteristic of the bark of the basal portion of the seedling stem. This layer does not contribute to the yield but provides extra depth for the tapping knife, and is useful for knocking in spouts, etc. The tapper who is used to seedlings may at first find some difficulty in tapping buddings, but after he has accustomed himself to the thinner bark he should be able to do excellent work especially in a monoclonal block where the bark of every tree is of similar thickness and consistency.

Girth Criterion.—The minimum girth for commercial tapping should be 20 inches at a height of 3 feet from the union.

Tapping System.—Tapping on a half spiral cut either on alternate days or once in three days is recommended. The milder system should be adopted for clones such as Tjirandji I and B.D. 2 which are predisposed to develop Brown Bast in the early years, and for all clones in the drier localities. There is evidence that some clones will respond best to one system and others to another, but we do not yet know enough to ascribe to each clone the method best suited to it.

The Double Four system has given satisfactory yields in the case of two clones at Nivitigalakele over a period of three years, but girth increment has apparently been adversely affected and the system is not recommended for young budded trees on that account.

Bark Consumption.—An experiment to determine the optimum rate of bark consumption has recently been started at Nivitigalakele, and until the results are available it is difficult to make definite recommendations. The general rate of consumption in Ceylon is much lower than in Malaya or the Netherlands Indies, and it is possible that a certain amount of crop is thus

lost. The compensating factor of being able to keep the cuts at a lower average level does not apply with much force to budded trees, and it is probable that the average estate standard of $\frac{1}{2}$ inch per month on alternate day tapping could be exceeded to advantage. $\frac{2}{3}$ or $\frac{3}{4}$ inch per month, *i.e.*, 8 or 9 inches per annum, is suggested for alternate day tapping.

Height of Cut.—Cuts should be opened at a height of 40 inches from the union, measured from the lower end to the highest part of the junction. It is inadvisable to tap within a few inches of the union, but the practice of leaving the lowest scion bark untapped varies in the different countries. By the time tapping cuts opened now at 40 inches approach the union there will doubtless be further information on the subject.

Change-Over.—Controlled experiments on seedling trees have failed to reveal the advantages claimed for the almost universal Ceylon practice of changing panels once a year or once in six months, and it is suggested that the panels be tapped right out as is the universal custom in other countries. No objection, however, would be raised to the annual change-over if there is a preference for this practice, and in this case the second panel could suitably be opened at 20 inches on the opposite side.

Slope of Cut.—The slope of the cut should be at least 25 degrees and preferably 30 degrees. The reasons for having a steeper cut on buddings than seedlings are two-fold:—

(1). The thinner bark of budded trees gives a narrower channel for the flow of latex, and there is a greater tendency for the latex to overflow down the bark if the cut is too flat.

(2). The objection to steep cuts on seedling trees, *i.e.*, that the triangle of wasted bark at the base of the tree is thereby increased, is of no consequence with buddings as the lowest bark is of no special value.

Spouts and Cup-Hangers.—Owing to the absence of the corky layer it is difficult to anchor the type of spout which supports the cup sufficiently firmly into the budded tree without causing a wound. It is therefore desirable to provide a very light spout which cannot be knocked more than about 5 mm. into the bark, and have a separate arrangement for supporting the cup. The type of hanger used at Nivitigalakele is made of galvanised wire (14 gauge) and is secured to the tree by two "claws" at the end of the two arms. The "claw" is made by hammering and

bending the end of the wire and should not be more than 5 mm. long. It need only be pressed gently into the bark. Alternatively the expanding "concertina" type of support can be used.

IDENTIFICATION OF CLONES.

The object of this note is to draw the attention of the Estate Superintendent to the importance of verifying the authenticity of the planting material being used for his budgrafted clearings. The matter has recently come into special prominence owing to the discovery of incorrect plants in the nurseries at the Experiment Station, Nivitigalakele. These errors mostly resulted from faulty introductions and fortunately were detected before any very extensive damage was done, but in the course of checking the plants resulting from the sale of this material to estates frequent instances of confusion between clones have been observed, even on well-managed properties. In most cases the errors have not been very serious in that they have involved the mixing of two or more good clones in an area intended to be monoclonal, but now that there is a considerable market for budwood and budded stumps the harmful potentialities of multiplying and distributing an undetected and valueless "rogue" are very great.

The matter of prime importance is to ensure the authenticity of the plants in the budwood multiplication nursery. The fact that the original introduction was from a reliable source is no guarantee of its identity, for mistakes may occur under even the most carefully regulated conditions. The Research Scheme will arrange for an Officer to visit estates for this purpose as far as time permits, but the Superintendent should not rely entirely on outside assistance but should endeavour to familiarise himself with the characteristics of the clones he is using. Proficiency in the identification of clones comes only with constant practice and experience, but for initial guidance Planting Manual No. 5, "The History and Description of Clones of *Hevea Brasiliensis*," published by the Rubber Research Institute of Malaya, will be found of great value. As notified in the present and past issues of *The Quarterly Circular*, this publication may be purchased on application to these Laboratories.

PLANTING MATERIAL.*

R. K. S. MURRAY,
BOTANIST AND MYCOLOGIST

THE title — "Planting Material" — which I have chosen for this short talk this morning is, I am afraid, rather a misleading one as I only propose to deal with one or two aspects of what is a very comprehensive subject. The two types of planting material on which interest is now centred are budgrafts of tested clones and seedlings whose parentage, on one side at least, is known. What I propose to do this morning is to summarise the available information regarding the tapping of budded Rubber in commercial practice, and to give you an idea of the value of different classes of seedling material by comparison with budgrafts. If I recapitulate some of the information given in the published report of my visit to Malaya and the Netherlands East Indies a year ago I must crave the indulgence of those who have troubled to read it.

YIELDS OF BUDDED RUBBER IN COMMERCIAL TAPPING.

For some years past one has constantly heard the remark: "We know that small plots of buddings in experimental tapping have given very high yields, but where is the confirmatory evidence derived from the tapping of large areas in estate practice?" In reply to this question we have had, until quite recently, to counsel patience, explaining that the reasons why such figures have been slow in coming to the fore are mainly twofold:—

1. Because the extensive planting of clones which may be regarded as "proved" did not commence until about 1928 so that the trees would not be ready for commercial tapping until about 1934; and

2. Because the advent of Restriction made it unnecessary to tap these young areas, most estates preferring to "nurse" their young clearings and obtain the restricted crop from the mature trees.

* An address given to Kalutara Planters' Association on December 2, 1937.

In most of the areas planted prior to 1928 the buddings were of untested or only partly tested clones and were often interplanted with seedlings, so that although the results were, in point of fact, very encouraging for this type of material they could not be regarded as representative of the yields obtainable from the clones then being commercially planted. So long as the improvement in planting material continues the yields from commercial tapping will always be, so to speak, one generation out of date, and even the figures of which I am about to speak refer mainly to the older clones which no longer find a place in most planting programmes.

The Table gives two series of figures of commercial yields of budded areas, and these are also represented graphically. I would draw your attention first to the continuous line in the graph. This represents the yields which I was able to collect in Malaya, Java and Sumatra during my recent tour in those countries. Each point on the line is the average yield in lbs. per acre for all the areas at that particular age, and the *figure opposite shows the total number of acres from which the results are derived. Thus in the 5th year, *i.e.*, 4-5 years of age, the average from 55 acres was 436 lbs. per acre. This was actually from only one estate. In the 6th year the average yield from 1,959 acres, represented on 14 different estates, was 466 lbs. per acre. I have not included any areas of less than 5 acres in extent, or any areas planted with mixed buddings and seedlings. The tapping system is $\frac{1}{2}$ sp. a.d. or $\frac{1}{2}$ sp. d.a.m. and in cases where the system differs from this I have applied an appropriate correction factor to bring all the yields into line. You will notice that the line is broken between the 9th and 10th years. This is because the figures up to and including the 9th year refer to clones which had been tested before being planted, while from the 10th year onwards the areas are planted with entirely untested clones.

I must warn you against supposing that the graph represents the type of progressive increase in yield to be expected from any particular area. In point of fact this would be much more regular, the eccentricities of this particular curve being due to the fact that the same areas are not always represented at each stage.

(* Reproduced in Table.)

I will now pass on to the broken line. This is based on a recent questionnaire sent to estates in the East Coast of Sumatra by the A.V.R.O.S. Proefstation, and is taken from a Circular published by that body only a month or two ago. The interpretation of the line is similar to that of the continuous line, but the *figures opposite each point refer to the number rather than the acreage of plantings contributing to that particular average yield. I do not know the acreage in each case, but the total area represented is just under 14,000 acres. These areas were all budded after the 1st July, 1925, and only pure budded plantings of over 25 hectares (about 62 acres) are included. Except for the fact that they refer only to one country this series of figures is really more representative than those shown in the continuous line, and you will see that the increase in yield is remarkably regular. The fact that the general level of yield is lower may be ascribed to the fact that the buddings date back earlier and are, in general, of poorer clones. They mainly comprise the older A.V.R.O.S. clones nearly all of which have since been discarded in favour of higher yielding material.

As a matter of general interest I have also reproduced in the dotted line the scale of assessment adopted for budded Rubber in Ceylon. Actually the assessments are given on a yield per tree rather than a yield per acre basis, girth measurements as well as age being taken into account, and I have assumed a stand of 100 trees of the requisite girth per acre. In fairness to the Budded Rubber Assessment Board I should point out that the ceiling of yield is not fixed at 1,000 lbs. per acre as the graph would lead you to suppose, but may be higher in certain circumstances.

Now what do these figures tell us? They show that the buddings planted some 8-12 years ago are, over areas of considerable extent, giving 2 to 3 times the yield that would be expected from unselected seedlings of the same age. The yields are still on the increase as evidenced by the fact that the lines show no signs of flattening out, and taking into consideration the fact that these figures are derived mainly from the older clones of more moderate yielding capacity it does not seem unreasonable to prophesy yields of 2,000 lbs. per acre from the better material at present being used.

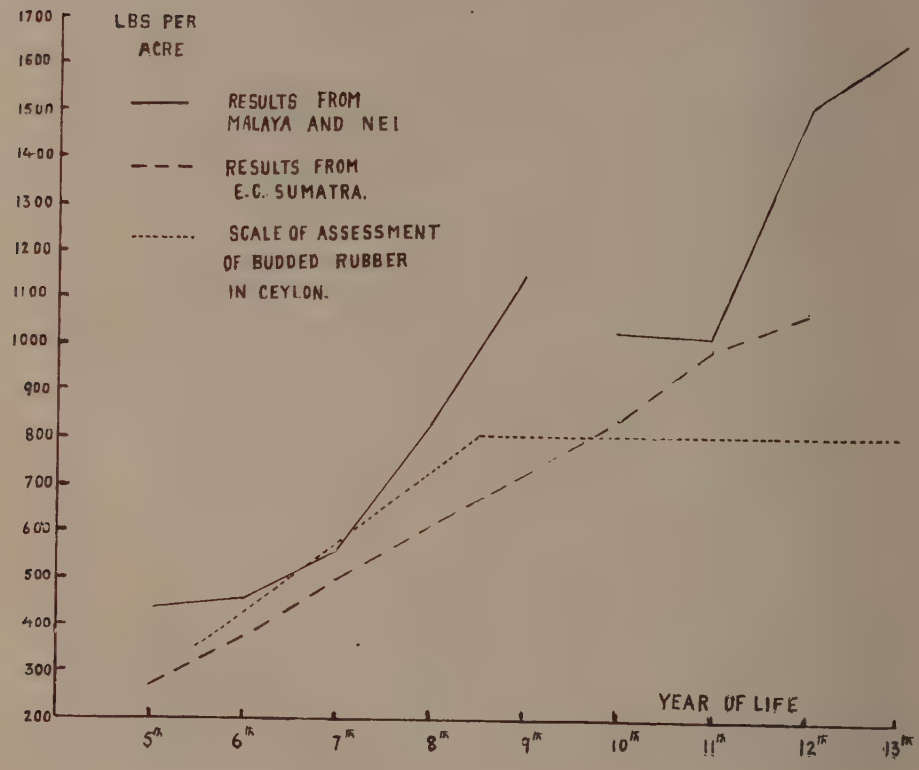
I should like to have been able to show you how the early figures from the tapping of proved clones in Ceylon compare

(* Reproduced in Table.)

YIELD RECORDS OF BUDDED RUBBER IN COMMERCIAL TAPPING.

	YEAR OF LIFE								
	5th	6th	7th	8th	9th	10th	11th	12th	13th
Miscellaneous figures									
from Malaya	436	458	565	835	1148	1027	1009	1512	1640 lbs. per acre
and N.E.I.	(55)	(1959)	(2325)	(720)	(60)	(244)	(1810)	(226)	(208) acres
A.V.R.O.S Figures									
from Estates in	273	375	499	610	739	844	999	1086	lbs. per acre
E.C. Sumatra	(9)	(29)	(24)	(23)	(20)	(11)	(8)	(5)	plantings

YIELDS OF BUDDED RUBBER IN COMMERCIAL TAPPING



with these results from other countries, but unfortunately I have not had time since my return from leave to collect together the records which we are now receiving from a number of estates. These are still mainly derived from relatively small areas, but it is very encouraging to note that in general the yields compare well with those from similar test tapping in other countries. Especially is this the case with Clone Tjirandji 1, which has probably been planted more extensively in this country than any other clone.

I do not think I should leave the subject of buddings without just hinting at one aspect which has not up to the present received much attention but which, I venture to predict, will become increasingly important; I refer to the matter of stock selection. Hitherto budding has been done on any sort of stock material, the only selection being on the basis of vigour in the nursery. This has, on the whole, given us satisfactory results and it is evident that most clones are not very particular as to the stock on which they are growing. Recent experiments, however, which I was privileged to see in Java and Sumatra appear to show a stock influence irrespective of the factor of vigour, and we shall probably find that although a particular clone gives satisfactory results on unselected stock it will give even better and more uniform growth and yield on stock derived from a particular source. Whether that source will usually be genetically related to the clone it is impossible to predict. As an example of the effect to which I refer, I might mention that the A.V.R.O.S. Proefstation consider that Clones A.V.R.O.S. 49 and 50 give a better yield when budded on to illegitimate seedlings of Clone A.V.R.O.S. 163 than on to other illegitimate clonal and ordinary unselected seedlings. It is even possible that we may be able to develop vegetatively raised stocks for commercial use as has been done in the apple growing industry, in which case the poor planter will have to know all about stock clones as well as scion clones. I hav'nt the time to do more than just mention this subject, but the point I wish to make is that the possibilities of improving the budgraft as a form of planting materal are not restricted entirely to the development of new clones.

SEEDLINGS AS PLANTING MATERIAL.

Before discussing the value of seedling trees as a form of planting material it will be advisable to define the various terms used for the seed of different origin. The term "clonal" seed is

commonly heard now-a-days, but unless the parentage of the seed is stated the term gives no idea of the value of the material. It is, in fact, somewhat misleading as the term "clonal" conveys to many people the sense of something tested and found to be of value, whereas such seed is often entirely untested, and where tested has sometimes been found to be little better than ordinary unselected seed. Four classes may be distinguished:—

(1). *Unselected Seed.*—Seed collected on the ground in an ordinary seedling plantation.

(2). *Selected Seed.*—Seed collected from recorded high-yielding trees in a normal plantation.

(3). *Illegitimate Seed of Clone X.*—Seed collected from a budded tree of Clone X. The origin of the pollen is unknown except that in a mixed stand of buddings it will probably be one of the other clones planted in that area. The seed may be hand picked or the mother parent identified by characteristics of the seed coat. This is the category into which most of the so-called "clonal" seed falls.

(4). *Legitimate Seed of Cross A × B.*—Seed obtained by the controlled cross-pollination of parent A (female) with parent B (male). A special form of this seed is "selfed" seed, where both parents are of the same clone.

With classes (1) and (2) it is unnecessary to deal in detail. The collection of seed from known high yielding trees was the earliest step in seed selection, and general experience has shown that such progeny usually gives appreciably higher yields than ordinary unselected seedlings. The only yield figure obtained from this class of material during my tour was one of 860 lbs. per acre at 12 years old compared with 1,073 lbs. per acre from a neighbouring block (258 acres) of mixed unproved buddings and selected seedlings 18 months younger.

The testing of illegitimate and legitimate seedling families has engaged the attention of the research organisations in Malaya, Java and Sumatra for some years. In a short talk of this nature I cannot give you a lot of figures, but the main conclusions reached are that where the seedlings result from the cross pollination of carefully selected parents the progeny give yields similar to those of what may be termed good average clones, the best families being on a par with the highest yielding clones. Illegitimate clonal seed, *i.e.*, seed whose mother parent is

known but father unknown, is, in general, superior to unselected seed but inferior to buddings of the best clones. Clones vary greatly in regard to their value as seed parents, and a clone that is valuable *per se* is not necessarily a good parent. It is thus necessary to test clones as seed parents just as it was necessary to test the buddings, and not only yield but also secondary characteristics such as bark renewal, liability to wind damage, Brown Bast, etc. have to be considered. The testing of seedling families progresses more slowly than the testing of clones as they cannot be multiplied so rapidly, and we do not at present know nearly so much about the value of clones as seed parents as we do of the buddings themselves. There are, however, certain clones whose illegitimate seedling progeny are giving very promising results, and the A.V.R.O.S. Proefstation have advanced to the stage of giving out a list of 12 clones and suggesting that up to 20 per cent of any replanted area be planted with illegitimate seedlings from these clones, provided that the areas from which such seed is taken are planted entirely with these and other good clones and do not include seedling plants. In Malaya and Java, also, certain very promising clonal parents are being disclosed, and I might perhaps give you a list of the clones which we have in Ceylon which are of special interest in this respect: Tjirandji 1 and 16, Bodjong Datar 2, (as a male parent) Pilmoor A 44 and B 84, Prang Besar 24, A.V.R.O.S. 80, 152 and 163. You will notice that this list includes some clones which are of no great value as buddings. It also excludes many of the best clones, in some cases because little or nothing is known of their seedling progeny but in others because they have been found to be of little value as seed parents. This emphasises what I have already said, that a high yielding clone does not necessarily produce high yielding seedlings and that every family must be tested before the seedlings can be recommended for commercial planting. As you are aware, the buddings of certain clones develop undesirable secondary features such as liability to wind damage and to Brown Bast, poor bark renewal, fluting of the stem, etc. Seedlings often inherit these parental characteristics, so these matters also have to be considered when testing the families.

We may summarise the present situation regarding our knowledge of legitimate and illegitimate clonal seed by saying that we have reached the same stage that we were at with buddings about 8 years ago. Certain families are giving very

promising results in experimental tapping, but confirmatory evidence from commercial tapping is almost completely lacking.

And now for a brief consideration of the local availability of seed which might be suggested as an alternative form of planting material to buddings. The type of seed which could be collected in considerable quantities from the older budded areas in Ceylon is illegitimate seed of which only the female parent is known. It follows from what I have already said that this seed could not be recommended unless the mother is known to be a good parent. Few of the clones known to be good parents have been planted in Ceylon on a sufficiently extensive scale for seed uncontaminated by pollen from ordinary selected seedlings to be available, but an exception may be made in favour of Tjirandji 1. Three years' test tapping results are available in Java from hand pollinated seedlings of the crosses TJ. 1 × TJ. 16, TJ. 16 × TJ. 1 and TJ. 1 "selfed." All these are giving very promising results though it must be conceded that the percentages of Brown Bast and wind breakage are high. Seed collected in the middle of a monoclone block of Tjirandji 1 20 acres or more in extent can be relied upon to be mainly "selfed" seed, and might, we suggest, be planted on a small scale, say not more than 5 per cent of any particular clearing. Similarly for seed collected from a mixed planting of TJ. 1 and TJ. 16 or from TJ. 1 mothers where monoclone blocks of these two clones adjoin. Where such seed is used the initial planting density should be higher than for buddings as there will be greater scope for selection and thinning out on the basis of early tapping tests.

Earlier in this section I referred to the good results that are being obtained with legitimate families, *i.e.*, seedlings resulting from the controlled crossing of selected parents, and we may ask: "To what extent can seed of this nature become commercially available?" Hand pollination is usually regarded as an operation which is the peculiar prerogative of the experimental plant breeder, but when I was in Java I met a very enterprising Chinese proprietary planter who was crossing Tjirandji 1 and 16 on a large commercial scale. I understand that during this year's flowering season he has made about 1,000,000 pollinations which, counting on 5 per cent successes, would give him 150,000 seed, and he finds a ready market for the seed at F1. -/25 each. He has trained an army of Soendanese women for this work, and I see no reason why Sinhalese women could

not be similarly employed. If anyone would like to try hand pollination we shall be very glad to give details of the technique employed.

A more practical means, however, of obtaining seed of good parentage is by planting buddings of the desired clones in a seed garden. It is not essential that this should be isolated miles away from the nearest Rubber, and the extensive replanting which is at present being undertaken offers an excellent opportunity of establishing such gardens. A suitable layout would consist of a central block of, say, 10 acres comprising the actual garden from which the seed is going to be taken; this would be planted with buddings of the two or more clones chosen as parents. This would be surrounded by a belt about 100 yards wide which would be planted either with the same mixture of clones or else with a single clone such as Tjirandji 1 known to give good pollen. Such a layout would involve an area of 35-40 acres and there would be little chance of outside pollen reaching the central garden. I would only suggest planting clones such as Tjirandji 1 and 16 and Pilmoor B 84, which give excellent buddings as well as being good seed parents, so that if subsequent experience causes us to modify our views regarding the value of the seedling families the area would still be good for ordinary tapping. I hope estates with large replanting programmes will consider laying out seed gardens of this nature, and we shall be very glad to give advice to any one interested.

ROOT DISEASE WITH SPECIAL REFERENCE TO REPLANTING.*

R. K. S. MURRAY,
BOTANIST AND MYCOLOGIST

THE last time I had the pleasure of addressing this Association was in October, 1935, when I spoke on certain practical aspects of replanting procedure. At that time interest in replanting was only beginning to awake and I expect few of those present had had experience of the work. Today, I am glad to say, there are few Company-owned estates in the major Rubber districts on which replanting programmes have not been initiated and most of you have probably encountered the problems with which this work is beset. One of the most interesting and difficult of these problems is concerned with the occurrence of root disease in replanted clearings, and I have chosen this as the subject of my address this morning as it has, I believe, evoked wide-spread interest, and sometimes apprehension, during my absence from Ceylon for the greater part of last year. I think I am right in saying that few estates have attempted, as is being extensively done in other countries, to replant land known to be affected with root disease, and it is the somewhat unexpected appearance of disease in areas which were thought to be free from the causative fungi, as judged by the history of the former stand, that has evoked feelings of doubt and apprehension. A clear understanding, however, of the mode of living and parasitism of the fungi responsible for root disease goes a long way towards removing the element of surprise at these outbreaks, and I want in the first place to review briefly their life history.

At the outset I must make it clear that I am referring to the true root parasites such as *Fomes lignosus*, *Fomes noxius* (the cause of Brown Root disease) and *Poria hypobrunnea*, all of which are essentially similar in their methods of parasitism and spread, and not to *Ustulina zonata* which is not a true root parasite.

* An address given to the Sabaragamuwa Planters' Association on January 28, 1938.

We will start at the beginning in the jungle before it is felled for planting Rubber. These fungi are present in what may be termed biological equilibrium with their hosts and nowhere is infection easily apparent. An odd tree of a susceptible species may be killed here and there, but the conditions are unfavourable for the spread of the fungus for three main reasons. In the first place only a certain proportion of the many forest species is susceptible to attack; secondly, the network of small roots belonging to the shrubby undergrowth affords an unfavourable medium for the spread of the fungus by means of its rhizomorphic strands; thirdly, the relatively large amount of organic matter in the surface layers of the soil favours the existence of saprophytic fungi and bacteria which are antagonistic to the parasite. When the jungle is felled the equilibrium is upset, and if the land is then planted with a single susceptible species — in our case Hevea — the conditions become favourable for the spread of the fungi.

At this stage it is important to consider just how these fungi spread, for upon their method of spread will depend the measures needed to control them.

Throughout the plant kingdom there are two alternative methods of propagation which may respectively be called "generative" and "vegetative." The generative phase in fungi of the Fomes type is represented by the fructifications with which you are all acquainted. At a certain stage in their development these fructifications, or "fruit-bodies," bear spores which correspond in function to the seeds of higher plants. These spores, when ripe, become detached from the parent body and are easily blown about by the wind. Their function, when they alight on a suitable potential host such as the end of an exposed stump, is to germinate and thus found a new colony. At one time it was supposed that this was an important means of propagation of, for example, *Fomes lignosus*, but recent work in Malaya indicates that spore infection is entirely subordinate to vegetative propagation as a means of spread.

For vegetative propagation the Fomes type of fungus has evolved a highly successful structure in the form of the rhizomorph, which is a specialised form of mycelium. You are all familiar with the whitish root-like strands which are to be seen on the surface of roots attacked by *Fomes lignosus*. These are the rhizomorphs and they endow the fungi which develop them with a high degree of mobility. Although these rhizomorphs

can grow for a certain distance without actual contact with woody material, as witnessed by their spread over covered stones and boulders and along runners of creeping cover crops, it is along the exterior of lateral roots that they chiefly advance. Where a healthy root comes in contact with an infected root or stump the fungus grows from the infected root on to and along the healthy root.

Going back to the felled jungle, we are now in a position to see how the root disease fungi transfer themselves to the recently introduced Rubber plants. As I have already said, when the jungle is felled there are a number of foci of root disease fungi each represented by one or a group of infected stumps. In between these centres the stumps are quite free of the parasitic fungi with which we are concerned, and the foci may be regarded as knots in a mesh. It is probable that the position and extent of these knots are absolutely fixed by the acts of felling and burning and that the fungi do not spread away from them along jungle roots which were healthy at the time of felling. What happens is that the fungi continue to feed on the infected stump until an outwardly growing root of a young rubber plant comes into contact with it. Even then the infection may not be transferred for the fungus may still have a plentiful supply of food in the original stump and may not have formed any rhizomorphs. Sooner or later, however, the fungus will, so to speak, wish to seek for pastures new, and will spread on to the healthy Rubber root. For a time the fungus lives epiphytically and does not penetrate the cortex, but sooner or later it will probably become parasitic and kill the plant. If the root system of this plant is excavated it will be possible to trace the source of infection to the jungle stump, and by thorough removal of the stump and all roots in contact with it to eradicate the fungus completely from that particular area. If this work is carried out in the early years of the plantation, before the roots of the Rubber trees have joined up to form a network, the treatment is confined to the tree or trees whose roots have come into contact with the primary source of infection. At this stage we know that the fungus cannot, with rare exceptions, have spread to other Rubber plants because their roots are not in contact and spread by root contact is, for all practical purposes, the only means of propagation. Later, when the roots form an interconnecting system, the fungus can spread freely from tree to tree.

The bearing that the above sequence of events has on the practical problem of control is clear. If the presence of the disease can be detected in the early years the treatment can be confined to the removal of one tree and the source of infection in each focus. Isolation trenches are unnecessary at this stage because until the roots of adjoining trees come in contact with one another there is no means by which the fungus can spread. If, however, treatment at this stage is neglected, large disease complexes may be formed, and eradication of the fungus becomes a very difficult and often uneconomic proceeding.

I have dealt in some detail with the sequence of events when jungle is cleared for planting Rubber because the story when the Rubber trees, in their turn, come to be felled for replanting is essentially the same. I mentioned that in the natural forest the fungi lived in a condition of biological equilibrium with their hosts, and it seems that the same applies, or sometimes applies, to a normal stand of mature Rubber, though possibly not for altogether the same reasons. When a stand of old Rubber, in which no case of root disease has ever been recorded, is felled it was at first supposed that the root fungi were absent and that there would be no risk of the young plants becoming infected from old roots left in the ground. Recent experience has shown that this is not a safe assumption, frequent cases of root disease activity having occurred in young replantings whereas the old trees showed no signs of disease. In every investigated case, both in our own clearings at Dartonfield and on estates, it has been possible to trace the source of infection to an old Rubber root bearing the typical rhizomorphs, the fungi concerned being usually either *Fomes lignosus* or *Poria hypobrunnea*. This proves that the fungus must have been present before the old trees were felled, and it was probably in the wood of a root in a condition of what may be termed "subdued parasitism:" in other words, in biological equilibrium with the host as in the jungle. When the trees are felled the equilibrium is upset, and we have the same sequence of events as I described in the case of planting forest land. As we know from experience that *Fomes lignosus* can be actively parasitic on mature trees it is at first sight difficult to understand for exactly what reasons it should sometimes become quiescent. Some work carried out in Sumatra a few years ago with *Fomes lignosus* goes a long way to elucidate this matter. It was shown that Fomes is really only weakly parasitic to Rubber and will only kill a tree under certain conditions. It was found, for example, that Fomes decay often stops without treatment and

of its own accord. In such cases the decayed patches become surrounded by callus and eventually heal over completely. This, I think, provides the clue to the apparent mystery, and we must think of the root fungi, particularly *Fomes lignosus* and *Poria hypobrunnea*, as being more generally present than the condition of the aerial parts of the tree would lead us to suppose.

Fomes lignosus has been found to kill young trees more easily than old trees, and this is apparently even more the case with Poria, which is very rare as a cause of disease in old Rubber but has occurred with considerable frequency in replanted clearings.

Having concluded that it is impossible to declare an area free from root disease fungi as evidenced by the visible condition of the old trees, we must consider what measures should be taken to protect the new stand. Such measures can be divided into two categories: (1) those taken before the appearance of disease, which may be termed "preventative," and (2) those taken after disease has made its appearance on the young trees, which may be termed "curative." Now it is clear that the more money is expended on what I have called preventative measures the less will have to be done in the way of curative treatment, and the problem resolves itself into striking the correct economic balance between these two categories. This will obviously vary according to the initial extent of infection. Taking the two opposite extremes: if every one of the old trees were infected at the time of felling it would obviously pay to remove all roots before replanting as this operation would have to be done sooner or later in any case; at the other extreme, if the old stand is entirely free from root disease fungi any money spent on preliminary precautionary measures would be quite wasted.

In the case of areas known to be infected, *e.g.*, replanting old Fomes patches, the position is simple and we recommend the entire removal (as far as this is practicable) of old roots. This advice also applies to sites cleared for nurseries whether root disease is suspected or not. The difficulty comes in dealing with the average piece of land on which there has been no past evidence of root disease activity, but which we now know may, and probably does, contain parasitic fungi. The safest course would be to regard all old roots as suspect and remove them, but this is an expensive proceeding and may, as we have seen,

prove to be an entire waste of money. The minimum figure for which any useful root removal can be carried out is about Rs. 10 per acre, and one would want to be satisfied that the loss of plants and subsequent expenditure on control measures was otherwise likely to amount to this sum before its expenditure could be justified. In some cases in my experience the trouble with root disease would, I think, have justified preliminary root removal, but in the majority of clearings this is not so, and at present we adhere to our former recommendation to leave the old lateral roots in the ground in areas where the presence of disease fungi is not definitely indicated. I realise that in the case of quite young replantings the story is not fully told, and it is quite possible that we may have to modify our position in the light of further experience.

In an attempt to find a means whereby the presence of the sources of infection could be detected at an early stage, Messrs. H. W. R. Bertrand and E. C. K. Minor have evolved a form of treatment based on the fact that certain leguminous bushy green manure plants are susceptible to the same fungi that attack Hevea, and I expect many of you have read their interesting contribution to *The Tropical Agriculturist* of September, 1937. The principle is that the roots of these plants will make contact with the "knots" of infection, succumb quickly to the disease and thus act as "indicators" of the presence of infective material. Without calling into question the efficacy of this procedure or its value in special circumstances, I must express doubts as to its general advisability largely on the grounds that it involves undesirable departure from orthodox agricultural practices. It is impossible to grow any of the common creeping ground covers in conjunction with the "indicators" as the former will climb up and swamp the latter, and it is doubtful whether the erect species alone give adequate protection against soil erosion on steep land. Moreover, the "indicators" cannot be lopped and utilised as sources of green manure as they frequently die after lopping for reasons quite unconnected with root disease. It is also possible that the "indicators" are often killed by root fungi which are either harmless to Hevea or so mildly parasitic as not to constitute a serious danger, in which case a great deal of work and undesirable soil disturbance is carried out to little purpose.

The measures that I have so far mentioned belong to the class that I have called preventative, and you will gather that

it is our present opinion that such measures are not justifiable on economic grounds in areas where the presence of root disease is not suspected. What, then, will happen if we leave "knots" of infected material in the ground and take no special steps to remove them or disclose their whereabouts? In course of time out-growing roots of the young Rubber plants will come in contact with the sources of infection in just the same way as I described for clearings planted from jungle, will contract the disease and die. If a reasonable degree of vigilance is exercised these plants can be discovered within, at most, a few weeks of their showing any symptoms of ill-health above ground, the source of infection can be traced and the causative fungus eliminated from that particular area. What I am proposing, in other words, is that the Rubber plants themselves should be the "indicators." This policy could only commend itself if the number of plants so lost were small, and if the "knots" of infection were disclosed before the fungus could spread a great distance. In most of the replanted clearings of which I have knowledge the number of casualties due to root disease amounts so far to considerably less than 1 per cent of the total stand Some of these clearings are quite recent but others are up to 8 years of age. Even 1 per cent is an insignificant proportion especially as the initial stand is usually much greater than the final stand aimed at. In the first two years or so the casualities can, of course, be replaced with supplies.

The extent to which the fungi may have spread during the time which elapses before their presence is discovered is really a more important matter than the incidence of disease in the first year or two, for upon the extent of spread will depend the amount of damage that will be done in future years. Although we have no precise information on this point there is reason to suppose that it is only during the first few months after felling, while the roots are still fairly fresh, that the fungi are likely to spread along them. Later, when the roots have been invaded by saprophytic fungi and termites, they are unlikely to play a part in the propagation of the fungi. As for the new root system of the young plants, we have seen that for all practical purposes the only means of spread is by contact from root to root so that this system will not act as a vehicle for the spread of the fungi until the roots of adjacent trees join and form a network. Although individual contacts will be made at an earlier age the network is not fully effective as such until the trees are 12-15

years old. If the existence of sources of infection are not revealed by the young trees by this time it probably means that the fungi have again entered upon a dormant phase and are unlikely to do much damage.

I have hinted in an earlier part of this address at the rôle that creeping cover crops may play in aiding the spread of these fungi, and mentioned that the rhizomorphs can spread along the runners without actual contact with woody material except at a distance of several feet. The presence of such a cover is therefore obviously a potential source of danger, and creeping covers should probably not be planted in areas known to be infected. We do not, however, deprecate their general use in replanted clearings as they serve a valuable agricultural purpose for preventing soil erosion, etc. In certain cases they may cause trouble, but it does not seem to be sound policy to forego the agricultural benefits of ground covers over the greater part of a clearing because of the possible danger in localised areas which usually form a small proportion of the whole.

Recapitulating our present advice on this subject, where the presence of root disease is definitely indicated we recommend the removal of all old roots immediately after felling, but where disease is not suspected we consider that it will usually prove uneconomic to undertake special precautionary measures. A certain incidence of disease in the new stand is to be expected, and when such a case occurs no expenditure must be spared to trace and remove the source of infection. Until the roots of neighbouring trees have made contact there is no need for isolation trenches.

In conclusion, I would like to warn you against accepting anything I have said this morning as a final judgment. The subject of root disease in relation to replanting offers a wide scope for investigation, and it is quite possible that if and when I am again given the honour of addressing this Association I may have a different story to tell. I have, however, endeavoured to allay the fears that are felt in certain quarters that root disease may prove a limiting factor in the success of replanting operations, and I think I am justified in doing so. We may certainly feel that in this respect we are more fortunately situated than our friends further East, who have to contend with far more root disease than anything we have in Ceylon.

MEETINGS, ETC.

RUBBER RESEARCH SCHEME (CEYLON)

Minutes of the forty-first meeting of the Rubber Research Board held at Dartonfield Estate, Agalawatta, at 10 a.m. on Wednesday, 26th January, 1938.

Present.—Messrs. L. B. de Mel, J.P., U.P.M., L. M. M. Dias, F. H. Griffith, M.S.C., R. J. Hartley, C. E. Jones, C.C.S. (Deputy Financial Secretary), Col. T. G. Jayewardene, V.D., Messrs. R. C. Kannangara, M.S.C., J. C. Kelly, F. A. Obeyesekere, C. A. Pereira, J. L. D. Peiris, B. M. Selwyn, E. C. Villiers, M.S.C., E. W. Whitelaw and Col. T. Y. Wright.

Mr. T. E. H. O'Brien, Director, and Mr. P. R. May, Visiting Agent, were also present by invitation.

In the unavoidable absence of the Chairman (Mr. E. Rodrigo), Mr. B. M. Selwyn was elected to the chair for the meeting.

1. MINUTES

Minutes of the fortieth meeting which had been circulated to members were confirmed and signed by the Chairman.

2. BOARD

Reported that Messrs. I. L. Cameron, L. M. M. Dias and E. W. Whitelaw had resumed membership on their return to the Island with effect from 1st December, 22nd December and 1st December, 1937 respectively. A vote of thanks was passed to Messrs. R. J. Hartley, S. F. H. Perera and A. H. Healey who had acted for them.

It was also reported that as Mr. I. L. Cameron was indisposed Mr. R. J. Hartley had been nominated to act for him with effect from 22nd January, 1938.

3. EXPERIMENTAL COMMITTEE.

Minutes of a meeting held on 14th December, 1937, were considered.

(a) *Recreation Room for Junior Staff.*—In view of the anticipated decrease in the Board's income due to the reduction in the export allowance it was decided to postpone consideration of the provision of a recreation room until 1939.

(b) *Engine-Driver Mechanic.*—A salary increment of Rs 10/- per month was approved.

(c) *Peons' Salary Scale.*—Decided to adopt the revised scale recommended by the Committee.

(d) *Installation of Sheeting Battery.*—Sanction was given for Messrs. Brown & Co., Ltd., to instal a Guthrie automatic sheeting battery at Dartonfield for demonstration and trial, subject to the same conditions as those laid down by the Tea Research Institute for tests of factory equipment.

(e) *1935 Replanting Experiment (Manurial Trial).*—In view of the reduced accuracy of the experiment due to the reduction of the number of replications from 4 to 3 consequent on the discovery of a rogue in the Tjirandji 1 block, it was decided to accept the Committee's recommendation to replant the whole area and re-commence the experiment in 1938. A further recommendation to replant an additional area of approximately 6 acres so that the number of replications would be increased to six, was also adopted. A vote of Rs. 1,293·92 was approved to meet the expenditure involved.

The subject of the identification of planting material was discussed and attention was drawn to the risk of errors occurring on estates. It was agreed that the Assistant Botanist's programme of work should include visits to estates for the purpose of checking planting material, so far as time was available.

4. ACCOUNTS.

(a) *Statements of Receipts and Payments of the Board and the London Advisory Committee* — for the quarter ended 30th September, 1937 (C.P.P. 653 and 661) were approved.

(b) *Dartonfield and Nivitigalakele Accounts* — for August, September, October and November, 1937 were tabled.

(c) *Reduction in Export Quota.*—Reported that the reduction of the export quota to 70 per cent. for the 1st quarter and 60 per cent. for the 2nd quarter would reduce the Board's income by Rs. 63,000/- if the latter rate of export was maintained for the 3rd and 4th quarters. The advisability of postponing the appointment of a Soil Chemist was considered. It was decided to proceed with the appointment and to have revised estimates prepared, omitting certain items of capital expenditure and economising on revenue expenditure where possible.

(d) *Fixed Deposits.* Reported that:—

1. A fixed deposit of Rs. 50,000/- at the Chartered Bank of India, Australia and China was renewed for 12 months from 31-12-37 at $1\frac{3}{4}$ per cent. interest.

2. A fixed deposit of Rs. 25,000/- at the Chartered Bank of India, Australia and China which expired on 31st December, 1937 was transferred to current account at the National Bank on that date.

Decided not to proceed with the investment of funds in long term securities until revised estimates have been considered.

5. STAFF

(a) *Appointment of Soil Chemist.*—After consideration of applications for the post it was decided that the papers should be forwarded to the London Advisory Committee for Rubber Research (Ceylon and Malaya) who should be asked to appoint a suitable officer either from among the present applicants or otherwise, at their discretion.

(b) *Appointment of Geneticist.*—Decided to appoint Dr. C. E. Ford who had been recommended for the post by the London Advisory Committee. A vote of thanks to the Committee for their valuable assistance was adopted.

(c) *Botanist and Mycologist.*—Reported the return of Mr. R. K. S. Murray from leave on November 1st, 1937.

(d) *Junior Staff Appointments.*—The following appointments were confirmed :—

Laboratory Assistant for Botanical Department.

Clerk for Botanical Department.

5 Rubber Instructors.

6. TECHNICAL OFFICERS' PROGRESS REPORTS.

Reports for the quarter ending September 30th, 1937, were adopted.

7. TRAINING IN RUBBER TECHNOLOGY.

Reported that the Minister for Labour, Industry and Commerce had nominated Mr. C. D. Dias for a six months' course of training in rubber technology. The nomination was approved.

Work on the demonstration of the practicability of local manufacture of vulcanised products was reviewed. It was decided that the programme of demonstrations had been satisfactorily completed and that work on the uniformity of raw rubber and the properties of latex should be undertaken by the Chemist on his return from leave. The Director was asked to prepare a programme of work for consideration.

8. LONDON ADVISORY COMMITTEE.

Minutes of meetings of the Committee and Technical Sub-Committee held on 1st October, 1937 were adopted.

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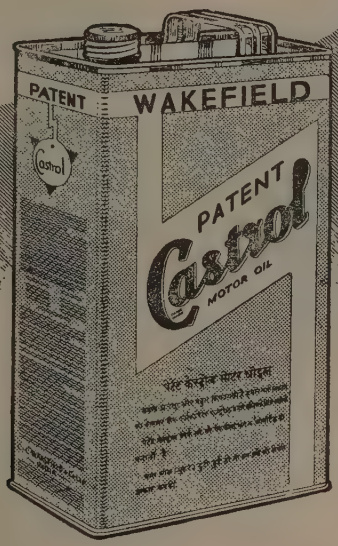

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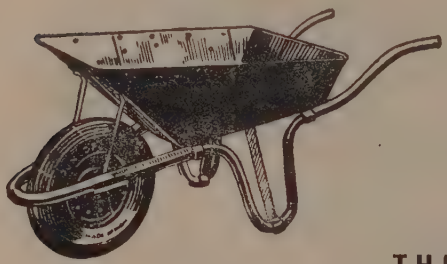

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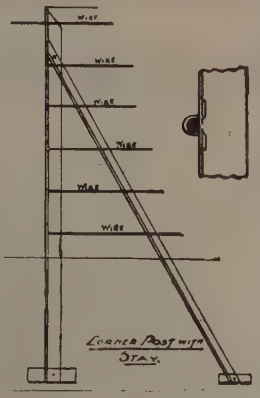

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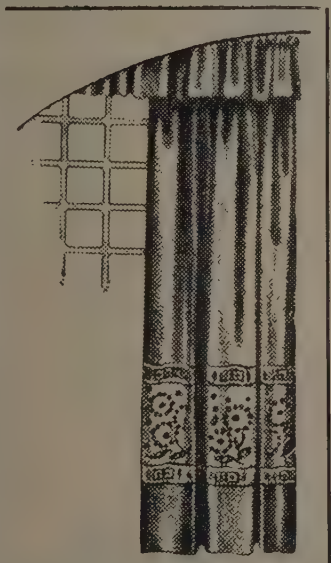

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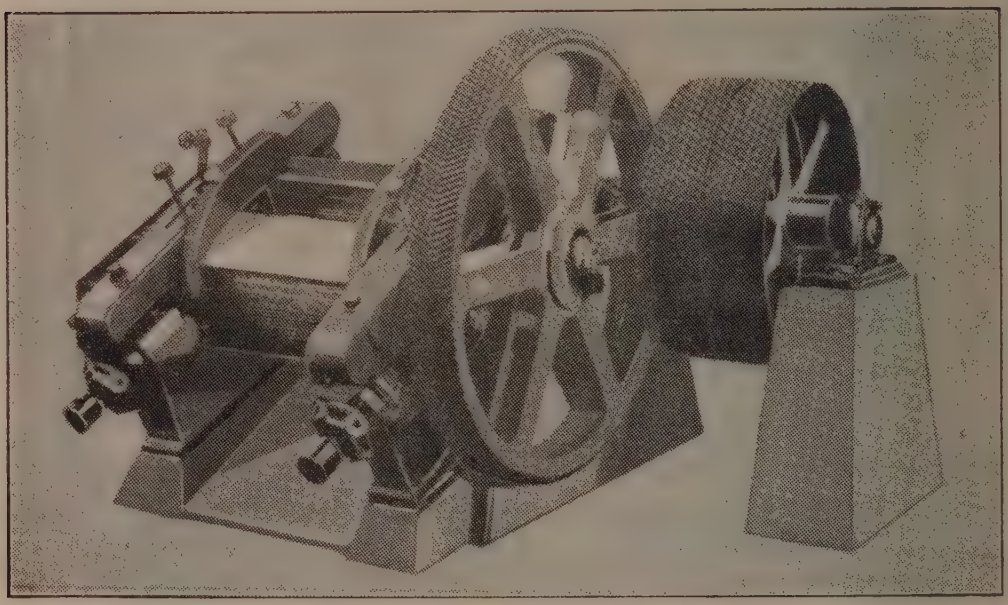

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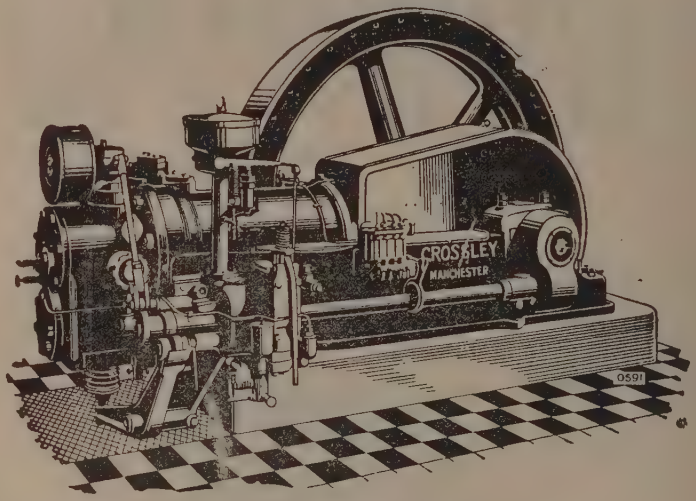

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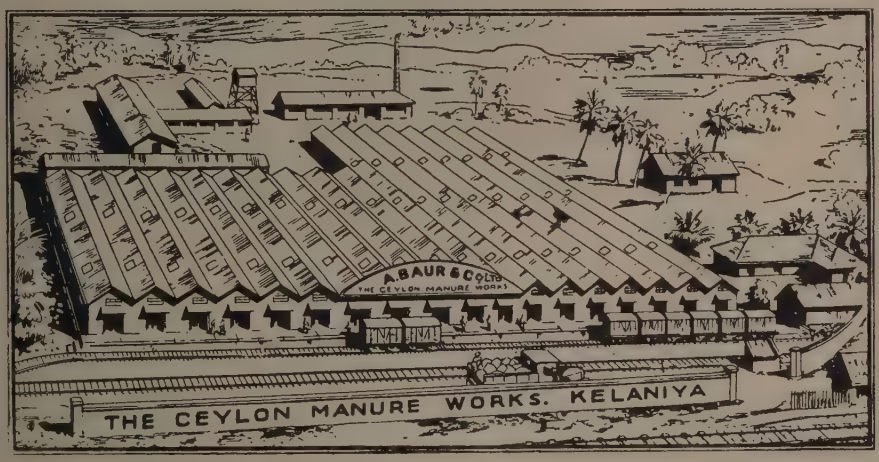

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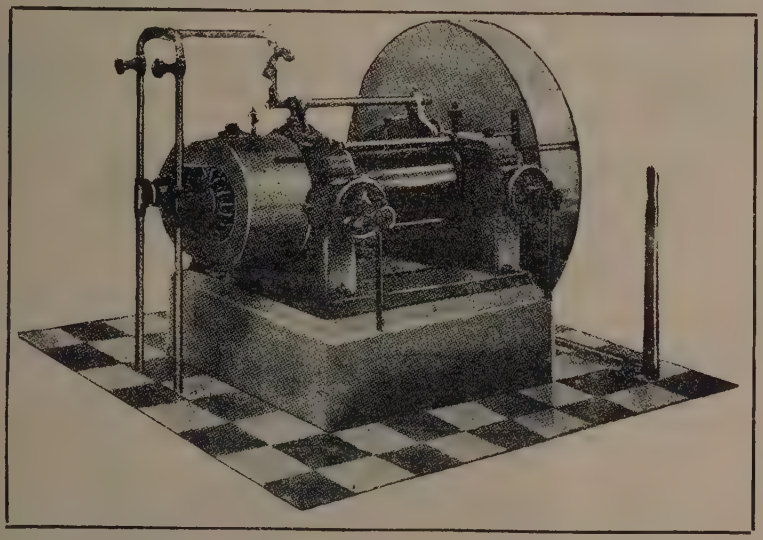

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